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(58) Field of search  
B7A

## (54) Foldable boat

(57) A foldable boat comprises a plurality of rigid panels (14, 16, etc.) defining the base and sides of the erected boat, the panels being linked by flexible waterproof material (10, 11) sealingly secured thereto to define foldable joint means. The joint means are arranged such that the side panels can be folded to overlie the base panels and form an assembly which can then be folded transversely to produce a further, flat assembly having a length substantially less than that of the erected boat.

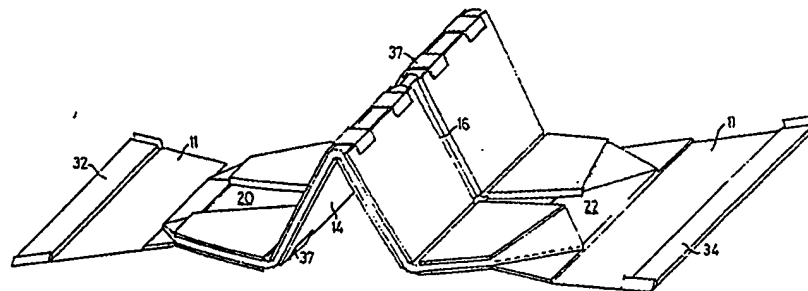


FIGURE 3

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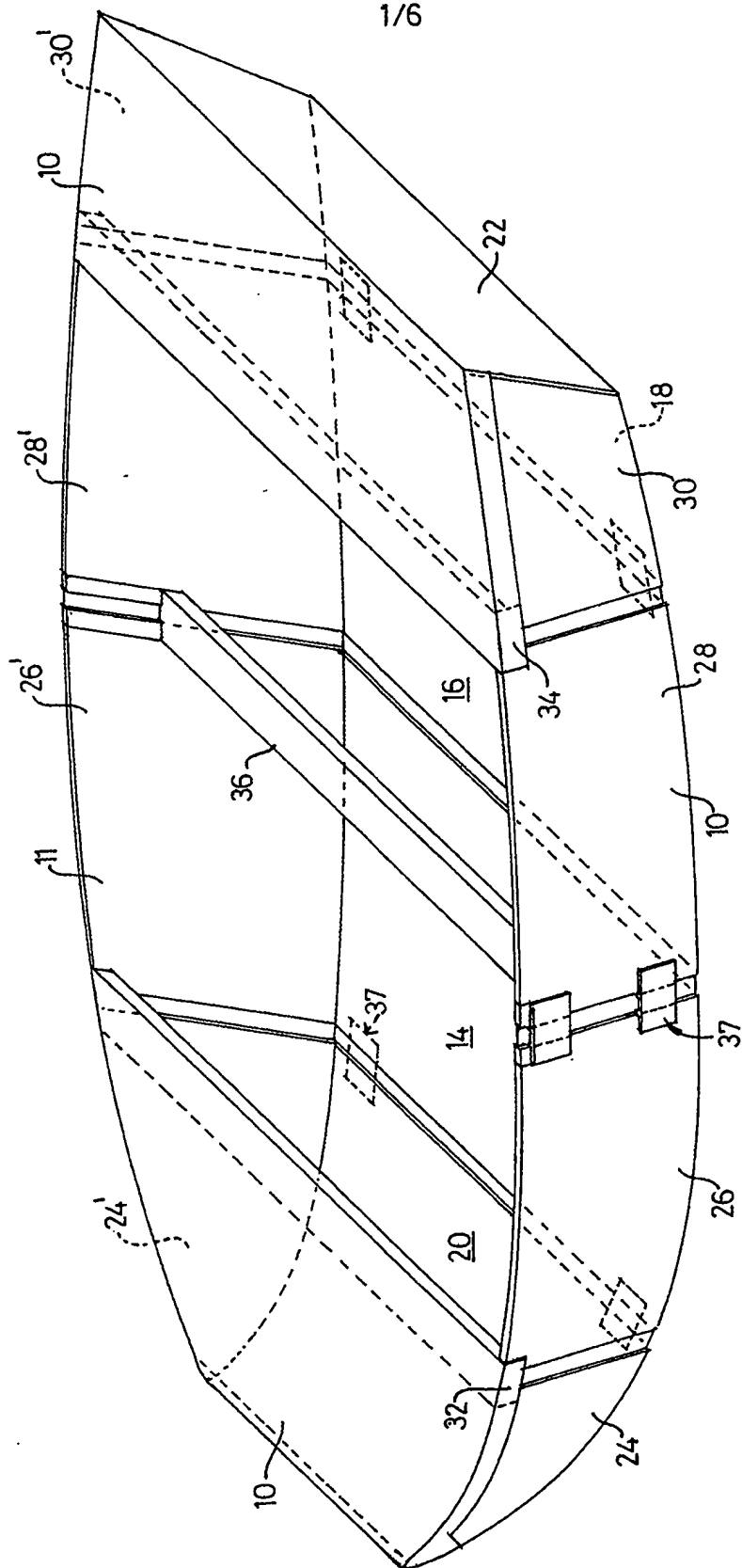


FIGURE 1

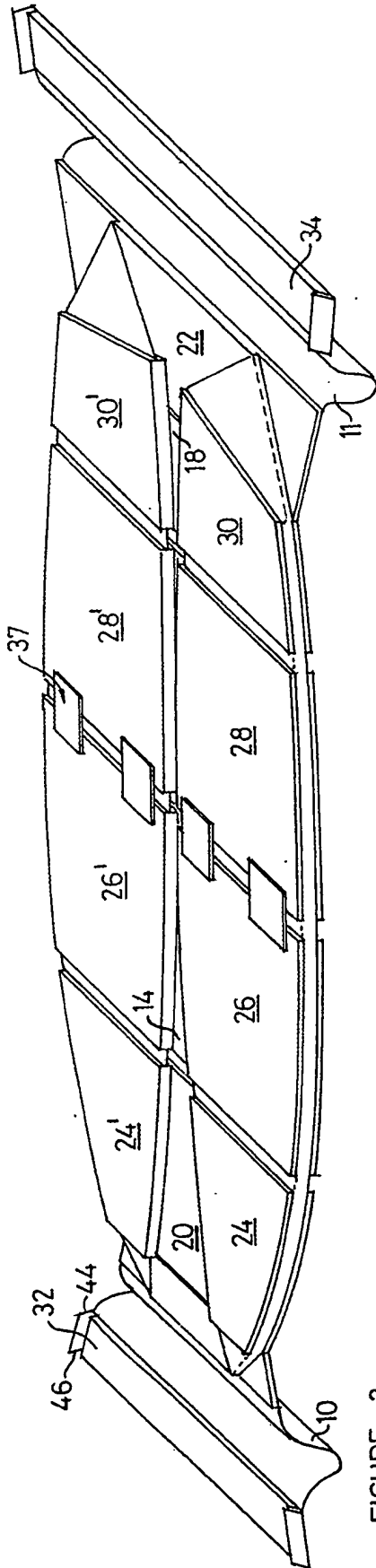


FIGURE 2

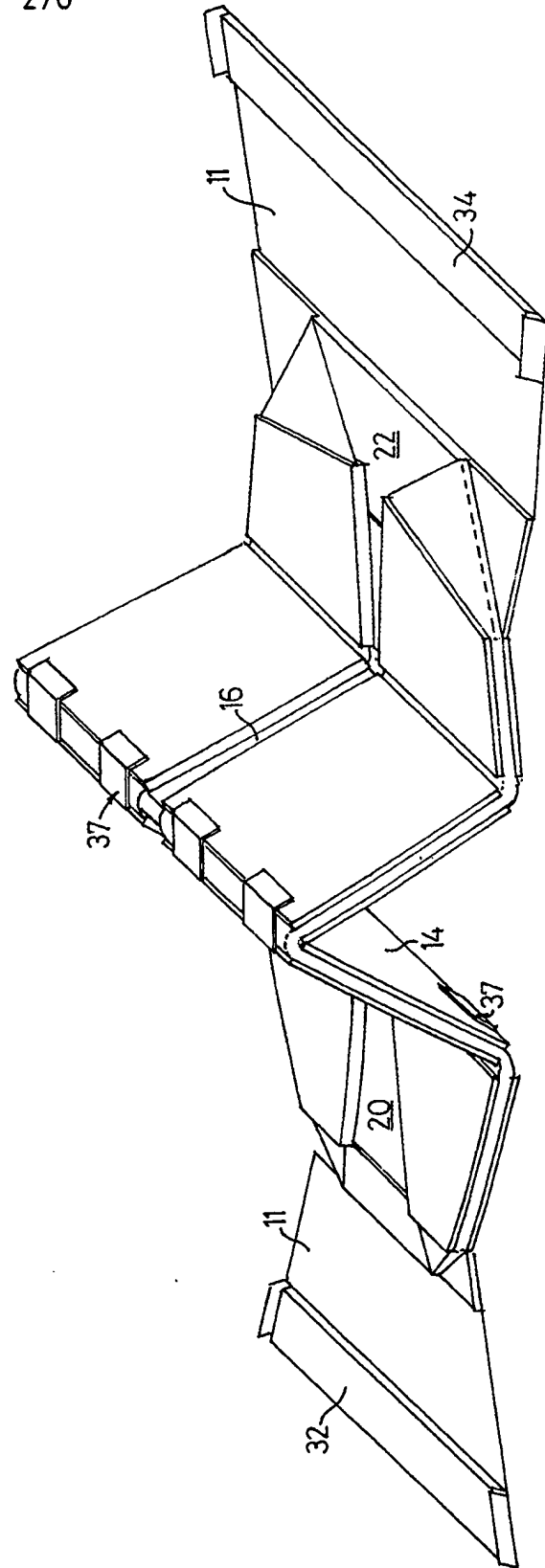


FIGURE 3

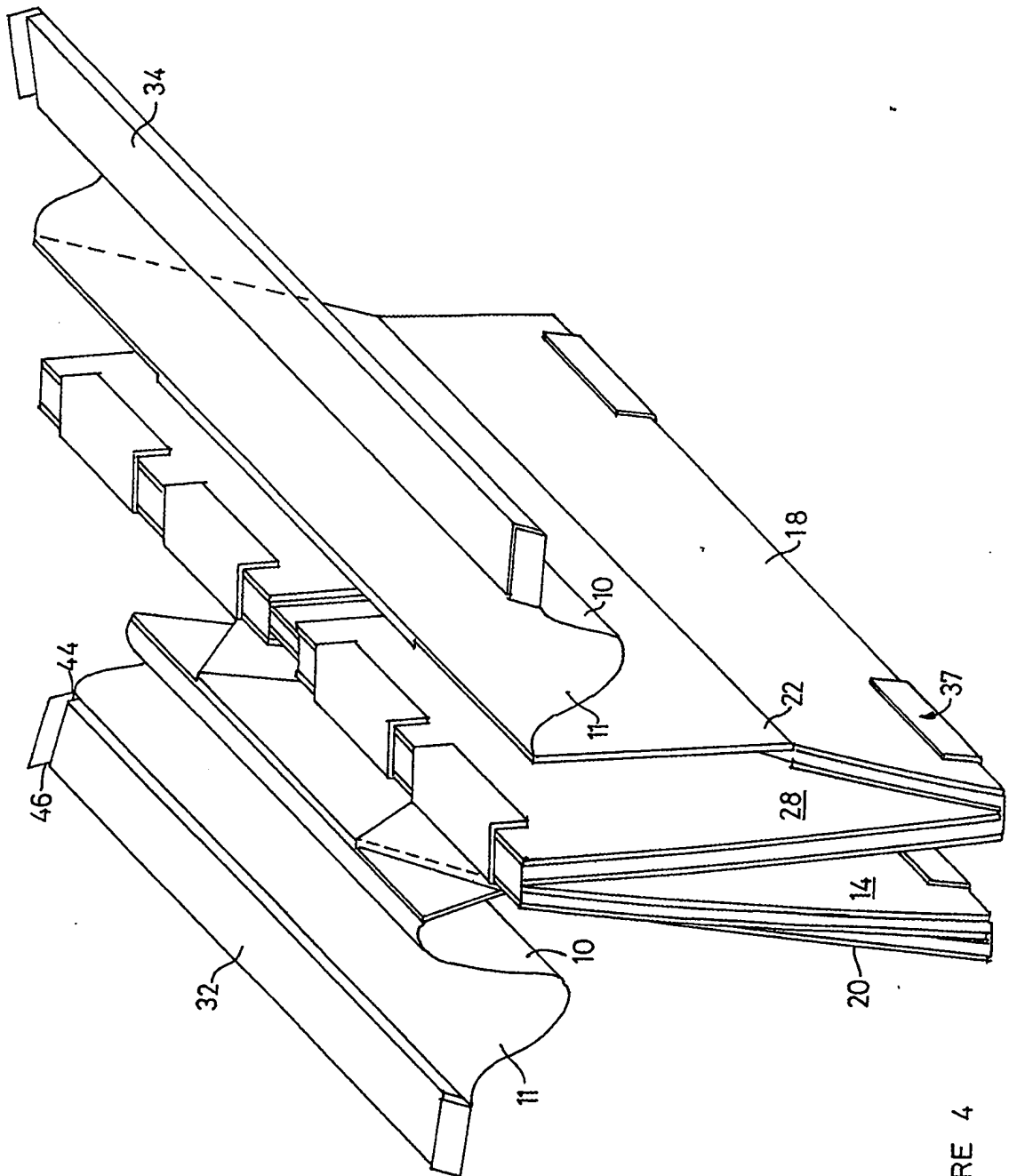
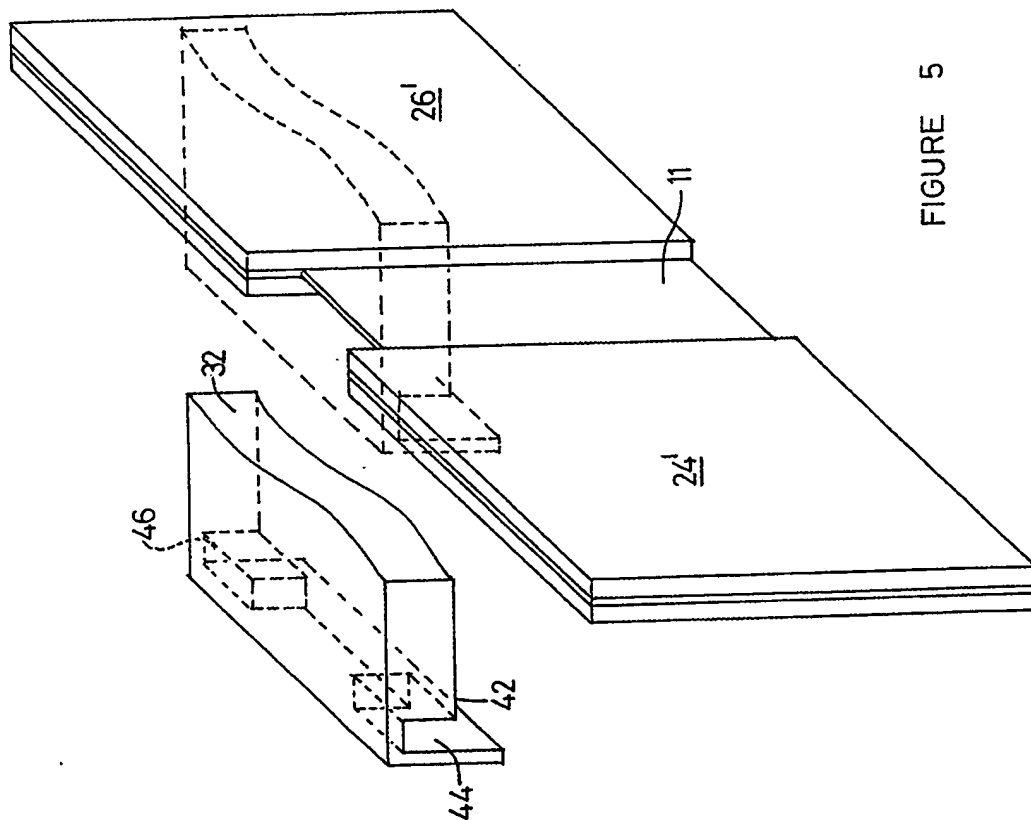
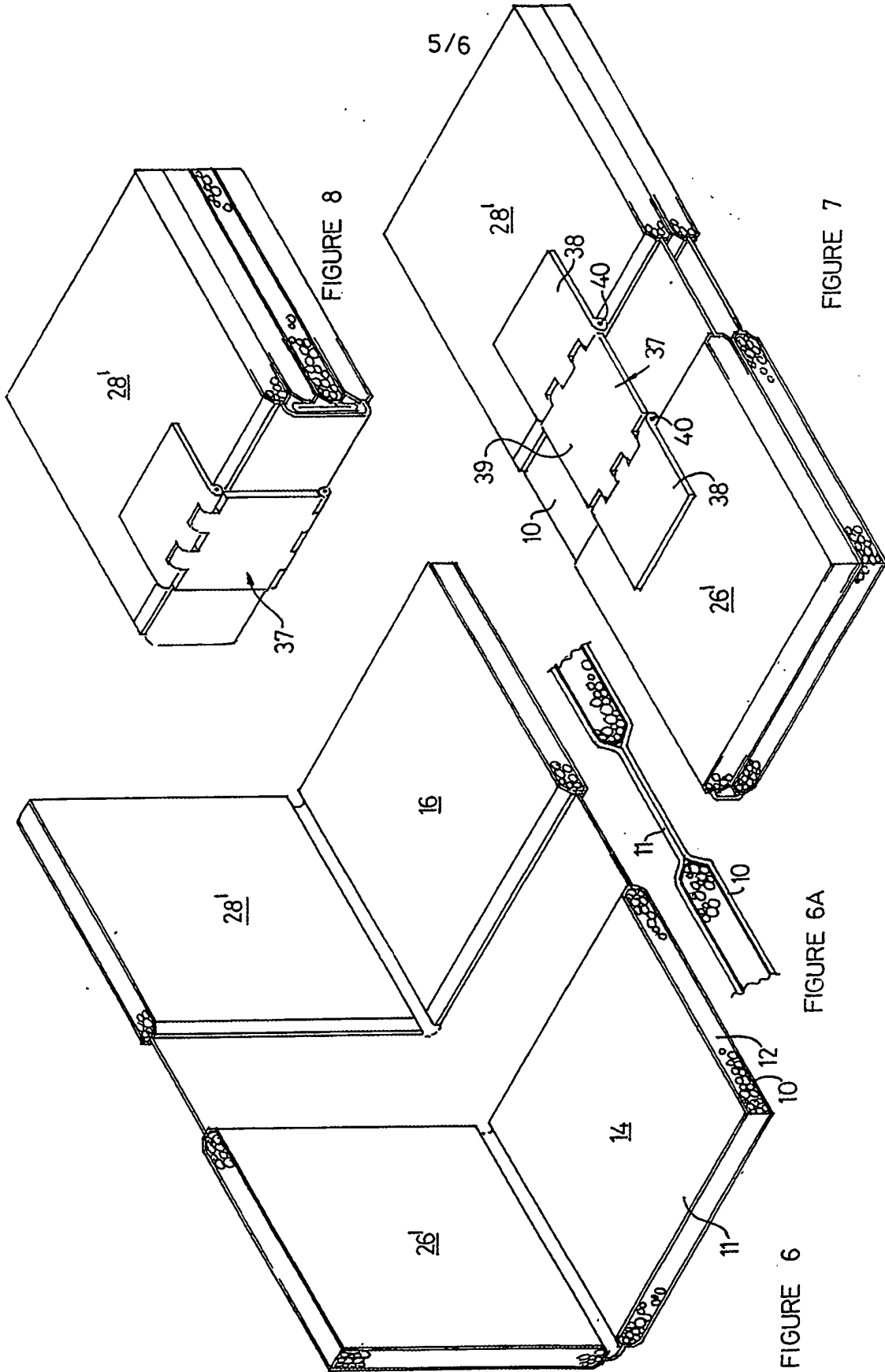


FIGURE 4





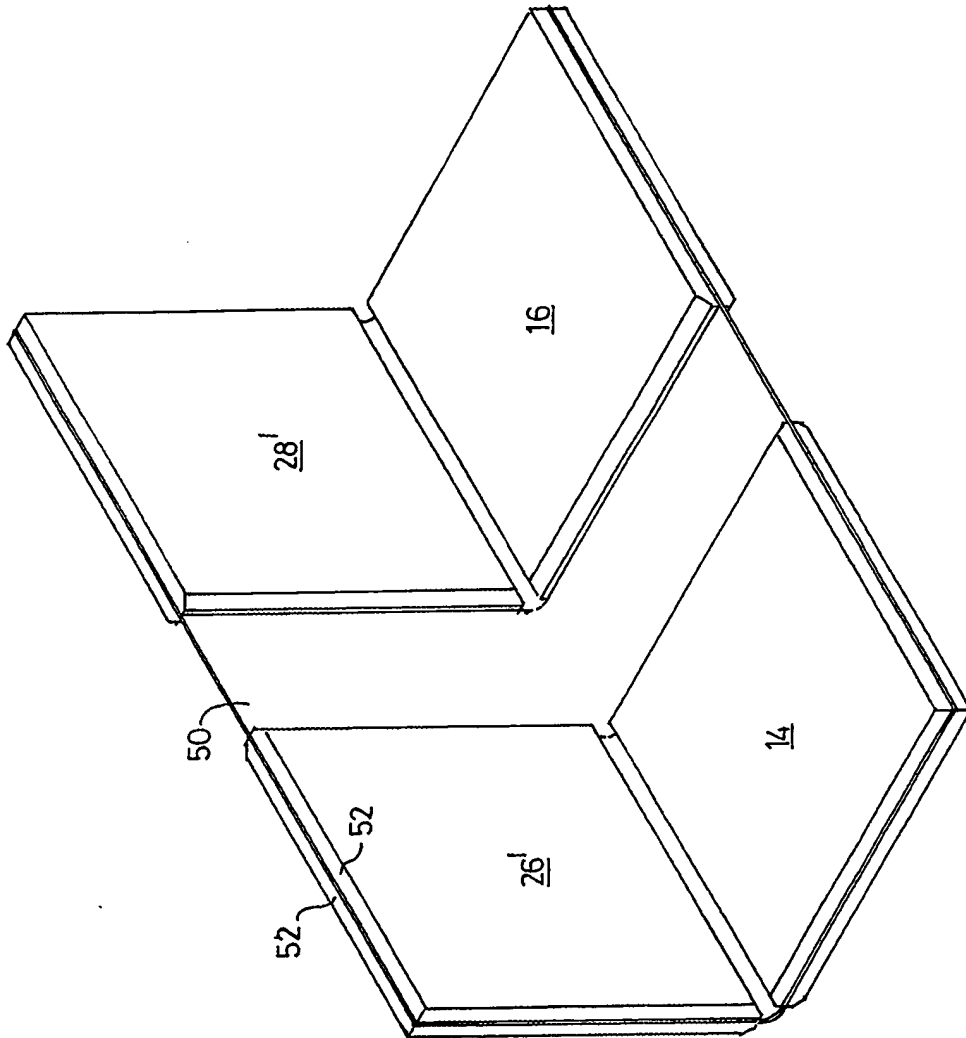


FIGURE 9

## SPECIFICATION

## Improvements in or relating to boats

5 *Field of invention*

This invention relates to boats and is concerned with a foldable boat.

*Background to the invention*

10 Foldable boats have been known for many years, and several different designs are available. These include boats of wood and fabric construction and more recent designs using foldable plastics such as polypropylene. The known boats in  
15 folded condition are all relatively long, having approximately the same overall length as the erected boat, hindering storage and transportation.

An alternative approach is provided by inflatable boats, which are relatively compact in deflated  
20 condition. However, inflatable boats are comparatively expensive and susceptible to damage. Further, inflatable boats are not sufficiently rigid for satisfactory use with outboard motors unless reinforced with wood panels, which provide storage  
25 and transportation problems.

*The invention*

According to the present invention there is provided a foldable boat comprising a plurality of rigid  
30 panels defining the base and sides of the erected boat, the panels being linked by flexible waterproof material sealingly secured thereto to define foldable joint means, the panels being securable in position to form the erected boat, the joint means  
35 being arranged such that the side panels can be folded to overlie the base panels, and form an assembly which can then be folded transversely to produce a further, flat assembly having a length substantially less than that of the erected boat.

40 The boat may additionally comprise panels defining the front and rear of the assembled boat, linked to adjacent panels by flexible waterproof material defining foldable joint means. The front and rear panels are conveniently substantially coplanar with the base panels during assembly and  
45 disassembly.

The boat is preferably constructed from one or more sheets of flexible waterproof material to which the panels are secured in appropriate positions, separated by regions of the material constituting the foldable joint means. Panels may be located on both sides of the flexible sheet, forming a sandwich construction. Alternatively, the panels may be sandwiched between two sheets of flexible  
50 waterproof material, with the two sheets conveniently secured, eg welded, together in the joint regions between panels.

The flexible waterproof material conveniently comprises nylon or polyester, preferably proofed  
60 with polyurethane, polyvinylchloride (PVC) or synthetic rubber in either case.

The panels are desirably formed of rigid PVC or polyurethane foam, polypropylene, PVC, ABS, or glass reinforced plastics, or a combination of such  
65 materials.

The presently preferred construction comprises panels of rigid PVC foam sandwiched between two sheets of PVC or nylon which are welded to each other in the joint regions between the panels.

70 Any suitably technique may be used for securing the panels to the flexible material to produce a water-tight bond, with glueing, eg using a rubber based glue, and high frequency welding being currently preferred.

75 The boat conveniently includes one or more thwarts, possibly integrally attached to other components. In one embodiment front and rear thwarts are provided, attached to extensions of the waterproof material and adapted to be removably fitted to extend across the width of the boat. Such  
80 thwarts may act to retain the boat in erected condition and give rigidity to the assembled structure. One or more separate, removable centre thwarts may also be provided.

85 Fixtures and fittings may be provided as appropriate, eg for oars, outboard motor etc.

In regions where folding of panels through approximately 90° is required, eg folding of the side panels to overlie the base panels (and possibly  
90 also front and rear panels) and possibly folding of the rear panel relative to the base panels, simple joint means may be provided by having an exposed width of the flexible material between the panels. The edges of adjacent panels are spaced  
95 apart sufficiently to permit the panels to overlie one another in collapsed condition, while preferably also being spaced so as to abut when the panels are inclined at an appropriate angle upon erection, eg about 90°, to prevent further relative  
100 movement and improve rigidity. The edges of the panels (or at least the outer panels in a sandwich construction) may be appropriately chamfered if desired.

Transverse folds, where folding of two overlying sections through approximately 180° is required, are conveniently achieved by use of two types of cooperating joint:

i) in one section adjacent panels are separated by an exposed strip of flexible material, and  
110 ii) in the other section adjacent panels are separated by an exposed strip of flexible material together with an associated double hinge arrangement which may be of conventional construction.

115 The two joint regions cooperate to permit a 180° fold, with the flexible strip on the inside of the fold and the double hinge acting as a spine on the outside.

The hinge is preferably arranged to limit relative movement of the adjacent panels in the opposite sense to that on folding, to maintain the panels approximately coplanar when erected for enhancing rigidity and stability of the erected structure.

The assembly may be folded transversely in one or more regions. For example, in one embodiment three transverse folds are provided, adjacent folds being directed in opposite senses, to produce a concertina-like folded arrangement with four superposed parts.

130 If more than one transverse fold is provided us-



ing cooperating joints of the construction discussed above, then the two types of joint are preferably alternated in the different sections to produce a staggered arrangement which provides good rigidity in the assembled structure.

The components are conveniently assembled using a jig with upstanding pegs on which pre-cut panels and flexible sheet material are assembled and secured in appropriate manner. Apertures for receiving the pegs are provided, with the pegs being removed after assembly and the apertures then sealed to produce a water-tight arrangement.

By allowing for transverse folding of the boat, the boat in folded condition can be very compact, facilitating handling, storage and transportation. A boat in accordance with the invention finds many applications, including use as a tender for larger vessels, for fishing and for general recreational use.

One embodiment of boat in accordance with the invention will now be described by way of example with reference to the accompanying drawings.

In the drawings

Figure 1 is a perspective view showing the boat fully erected;

Figure 2 is a perspective view of the boat in collapsed condition;

Figure 3 is a perspective view showing the boat in partly folded condition;

Figure 4 is a perspective view, to an enlarged scale, showing the boat in nearly fully folded condition;

Figure 5 is a schematic view illustrating fitting of a thwart;

Figure 6 is an isometric view of a joint region; Figure 6A is a detail of Figure 6;

Figure 7 is a view similar to Figure 6 showing the region folded once;

Figure 8 is a view similar to Figure 6 showing the region folded twice; and

Figure 9 is a view similar to Figure 6 illustrating an alternative panel construction.

#### Detailed description of the drawings

The drawings illustrate a foldable boat in accordance with the invention. The boat is of sandwich construction and comprises two sheets 10 and 11 of flexible waterproof material, eg of polyvinylchloride (PVC) or Nylon (Nylon is a Registered Trade Mark). A series of rigid panels 12, eg of rigid PVC foam, are secured, eg by being glued with a rubber based glue, between the sheets 10 and 11 to produce panel regions of sandwich construction (best seen in Figures 6 and 6A) defining the base, sides, front and rear of the assembled boat, the panel regions being interconnected by flexible joint regions in which the two sheets 10 and 11 are welded to one another.

The panel regions are as follows:

- 3 base regions 14, 16 and 18;
- 1 front region 20;
- 1 rear region 22; and
- 4 pairs of side regions 24, 24', 26, 26', 28, 28' and 30, 30'.

The panel regions and joint regions are arranged

and shaped so that the boat can be erected to the condition shown in Figure 1. The boat is held in this condition by front and rear thwarts 32 and 34, respectively, secured to material extensions and adapted to be fitted in position at the joint region between adjacent side panel regions. A centre thwart 36 is also provided, as shown in Figure 1. The thwarts and panel regions are sized and shaped to induce suitable curves in the sides and base of the erected boat, giving strength and rigidity. The construction and fitting of the thwarts will be described in more detail later.

The panel regions and joint regions are also arranged and shaped so as to permit collapse and folding of the boat. In order to achieve this the three thwarts must first be removed. The four pairs of side panel regions can then be inwardly folded to overlie the base, front and rear panel regions, as shown in Figure 2. The collapsed boat can then be folded transversely, as illustrated in Figures 3 and 4. This involves forming three 180° folds between adjacent sets of panel regions, adjacent folds being directed in opposite senses, to produce a compact, folded concertina-like arrangement as shown in Figure 4.

The construction of the joint regions permitting such collapse and folding will now be described with reference to Figures 6, 6A, 7 and 8.

These Figures show part of a typical jointed region, illustrating the joint regions between side panel regions 26' and 28' and base panel regions 14 and 16. These Figures also illustrate well the sandwich construction of the boat.

Firstly, side panel regions 26' and 28' are foldable inwardly through approximately 90° to overlie panel regions 14 and 16, as shown in Figure 7. To this end, joint means in the form of a strip of material 10, 11 is provided between the panels to permit such folding, with adjacent edges of the panel inner faces being spaced sufficiently far apart to permit the panels to overlie one another.

A similar joint arrangement is provided between the other side panels regions and other base panel regions and also at the transverse junction between the rear panel region 22 and adjacent base panel region 18, where folding through approximately 90° is required.

A different joint arrangement is used to permit transverse folding of two overlying sections through 180°. In this case two types of cooperating joint are provided:

i) in one section adjacent panel regions are separated by a flexible joint region consisting of a strip of material 10, 11, as shown between side panel regions 26' and 28' in Figure 6, and

ii) in the other section adjacent panel regions are separated by a cooperating hinged joint region similarly comprising a strip of material 10, 11 as shown between panel regions 14 and 16 in Figures 7 and 8. In addition, a hinge assembly 37 is secured to the panel regions. Assembly 37 comprises two similar side elements 38 each secured, eg glued, to an adjacent panel region. The side elements 38 are interconnected by an intermediate element 39 which is pivotally attached at 40 to the

adjacent elements in conventional manner. The hinge elements 38 and 39 are of rigid material, eg the same or similar to the material from which panels 12 are made.

- 5 The two joint regions cooperate to permit a 180° fold, as illustrated in Figure 8, with the flexible joint region on the inside of the fold and the hinge assembly acting as a spine on the outside of the fold.
- 10 The hinge assembly 37 is constructed to permit pivoting movement of adjacent hinge elements 38 and 39 through at least 90°, to permit folding between the conditions in Figures 7 and 8. Preferably, the hinge assembly is constructed for limited hinging movement only, and is such that further relative outward movement of panel regions 26' and 28' beyond the generally coplanar condition illustrated in Figures 6 and 7 is prevented. This feature enhances stability of the structure in erected condition.

The hinged joint region between panel regions 14 and 16 extends across the full width of the base of the boat, and a flexible joint region similar to that between side panel regions 26' and 28' is provided between the opposing side panel regions 26 and 28 so that the two side sections can both be collapsed inwardly and then the collapsed arrangement folded transversely.

Similar cooperating joint arrangements are provided at the other transverse fold regions, with the location of the flexible and hinged joint regions alternating between the base and sides of the boat to produce a staggered arrangement as shown in Figures 1 to 3. This staggered arrangement permits multiple transverse folding, as illustrated in Figures 3 and 4.

The construction and fitting of thwarts 32, 34 and 36 will now be described in more detail.

Front and rear thwarts 32 and 34 are of similar construction and each comprises a rigid crosspiece 42, eg of wood, metal, plastics or rubber, extending across the full width of the erected boat and secured to appropriately sized and shaped extensions of material 10, 11. As illustrated in Figure 5, the ends of the cross pieces are shaped for being secured by friction fit to the sides of the boat in the vicinity of flexible joint regions, the ends including recessed regions 44 and 46.

Centre thwart 36 is of generally similar construction but is completely removable and comprises a crosspiece which is rather broader (in fore-aft) direction and which is adapted to be removably secured by friction fit to the boat sides in the vicinity of a rigid joint region.

55 The illustrated boat is conveniently constructed using a jig comprising a flat base board with a series of upstanding pegs on which precut panels 12 are assembled with precut pieces of flexible material 10 and 11. To this end the panels 12 and material sheets 10 and 11 are provided with appropriately located holes for receiving relevant pegs.

During assembly the outer sheet 10 is first located on the jig. The outer panels of the base regions 14, 16 and 18 and of the front region 20 and

of the rear region 22 are then located on the jig, overlying sheet 10, and the panels are secured to the sheet, eg using rubber based glue. The inner sheet 11 is then located on the jig and secured to the panels to produce a sandwich construction. Side flaps of inner sheet 11 are folded in to overlie the jig and have secured thereto panels of the side regions. Side flaps of outer sheet 10 are also folded in and secured to the side region panels to produce a further sandwich construction.

70 When curing of the glue is complete the thus assembled components are then removed from the jig pegs, and the holes for the pegs are rivetted or glued to produce a watertight assembly. The boat is completed by addition of thwarts and fittings (not shown), eg for oars, outboard motor etc.

The illustrated boat (when erected) has the following dimensions:

Overall length 2.25m (7' 6")

85 Beam 1.20m (4' 0").

When folded the boat has the following approximate dimensions:

0.60m (2' 0") x 0.90m (3' 0") x 0.075m (3").

90 Other sizes of boat are also possible. For example the boat may be longer and include additional transverse fold regions. Additional thwarts may also be provided. Additional fittings may also be provided, eg support straps extending between the top of the sides and centre of the base.

95 The boat when erected has good rigidity as a result of the joint arrangements and thwarts, and is suitable for various purposes, eg as a tender, for fishing and for recreation. The boat is very versatile, being well suited for use with an outboard motor. In collapsed and folded condition the boat is very compact and so can be easily stored when not required for use, eg on a larger boat for use as a tender or in the home, and can be easily transported, eg in the boot of a car.

105 Figure 9 illustrates an alternative form of panel construction, in which a single sheet 50 of flexible waterproof material, eg of PVC or Nylon, has a series of pairs of rigid panels 52, eg of rigid PVC foam, secured thereto, eg by use of rubber based glue, to produce panel regions of sandwich construction.

## CLAIMS

115 1. A foldable boat comprising a plurality of rigid panels defining the base and sides of the erected boat, the panels being linked by flexible waterproof material sealingly secured thereto to define foldable joint means, the panels being securable in position to form the erected boat, the joint means being arranged such that the side panels can be folded to overlie the base panels and form an assembly which can then be folded transversely to produce a further, flat assembly having a length substantially less than that of the erected boat.

120 2. A boat according to claim 1, additionally comprising panels defining the front and rear of the assembled boat, linked to adjacent panels by flexible waterproof material defining foldable joint

means.

3. A boat according to claim 2, wherein the front and rear panels are substantially coplanar with the base panels during assembly and disassembly.

4. A boat according to claim 1, 2 or 3, constructed from one or more sheets of flexible waterproof material to which the panels are secured in appropriate positions, separated by regions of the material constituting the foldable joint means.

5. A boat according to claim 4, wherein panels are located on both sides of the flexible sheet, forming a sandwich construction.

6. A boat according to claim 4, wherein panels are sandwiched between two sheets of flexible waterproof material, with the two sheets secured together in the joint regions between panels.

7. A boat according to any one of the preceding claims, wherein the flexible waterproof material comprises nylon or polyester.

8. A boat according to claim 7, wherein the flexible waterproof material is proofed with polyurethane, polyvinylchloride (PVC) or synthetic rubber.

9. A boat according to any one of the preceding claims, wherein the panels are formed of rigid PVC or polyurethane foam, polypropylene, PVC, ABS, or glass reinforced plastics, or a combination of such materials.

10. A boat according to claim 6, comprising panels of rigid PVC foam sandwiched between two sheets of PVC or nylon which are welded to each other in the joint regions between the panels.

11. A boat according to any one of the preceding claims, including one or more thwarts.

12. A boat according to claim 11, wherein front and rear thwarts are provided, attached to extensions of the waterproof material and adapted to be removably fitted to extend across the width of the boat.

13. A boat according to claim 12, wherein one or more separate, removable centre thwarts are also provided.

14. A boat according to any one of the preceding claims, wherein in regions where folding of panels through approximately 90° is required joint means are provided by having an exposed width of the flexible material between the panels, with the edges of adjacent panels spaced apart sufficiently to permit the panels to overlie one another in collapsed condition.

15. A boat according to any one of the preceding claims, wherein transverse folds, where folding of two overlying sections through approximately 180° is required, are achieved by use of two types of cooperating joint:

i) in one section adjacent panels are separated by an exposed strip of flexible material, and  
ii) in the other section adjacent panels are separated by an exposed strip of flexible material together with an associated double hinge arrangement.

16. A boat according to claim 15, wherein the hinge is arranged to limit relative movement of the adjacent panels in the opposite sense to that on

folding, to maintain the panels approximately coplanar when erected.

17. A boat according to any one of the preceding claims, wherein the assembly is foldable transversely in more than one region.

18. A boat according to any one of the preceding claims, wherein the components are assembled using a jig with upstanding pegs on which pre-cut panels and flexible sheet material are assembled and secured in appropriate manner.

19. A foldable boat substantially as herein described with reference to, and as shown in, the accompanying drawings.

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